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By

Chi-kong Wu

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AIRPLANE BRAKE PARACHUTE

WU Chi-kong

The brake parachute is also called a drag parachute, which is suitable for a small high-speed airplane as an economical and effective landing-speed reducing facility. This article simply introduces a new type of brake parachute system which opens in the air.

The rapid development of the aviation industry in our country is followed by the gradual increase in the speed and weight of the airplane, and because of the continuous increase in the landing speed of the airplane, the landing run of the airplane has also correspondingly increased, that is to say, the airplane runway in the airport has to be very long. If the airport runway does not satisfy this requirement, then the airplane will run out of runway while landing and cause an accident.

In order to avoid an accident, people have tried to increase the length of the runway to satisfy the requirement of the landing run; thus, the runway becomes very long. The landing run of a 6- to 7-ton fighter is more than 2,000 meters, while that of a 50-ton bomber is more than 3,000 meters; and a 100- to 150-ton heavy bomber has a runway 6 kilometers long. Increasing the length of an airport runway directly influences strategy and economics.

From the viewpoit of strategy, a long runway exposes the target easily. It is not easy to conceal and, during war, once any section of the runway is bombed by the enemy, airplanes cannot take off, cannot strike the enemy on time, and the war is affected. If the takeoff and landing run needed by the airplane is short, the airplane can still takeoff and land to intercept enemy's airplanes, thus increasing combat efficiency greatly. Furthermore, if the airplane run is short, some small island in the sea could have an airport built on it so that the enemy's airplanes could be intercepted over the sea, and the sacred missions of protecting the Mother Country will be even better accomplished. From the economic point of view, the longer the airport runway, the greater the cost. According to foreign statistics, to lengthen a cement runway 37 cm thick by 300 meters costs U.S. $500,000, which is over a million in People's currency.

GENERAL SPEED-REDUCING DEVICE

From the above-mentioned conditions, we are forced to study some effective airplane landing-speed reducing method to shorten the airplane run. In the beginning, people first thought of using the airplane's own air drag to reduce speed. In the process of an airplane's landing, by increasing the airplane's landing attack angle, that is by increasing the frontal area of the airplane, at the same time by lowering the wing flaps and air damper (also called airbrake) to reduce speed, the length of the runway might be reduced. At the same time, people also put brakes in the airplane wheels similar to those in automobile wheels. During the landing run, after the touch-down of three wheels of the airplane, the brakes of the airplane wheels are applied to slow down the rotational speed and to increase the friction between the wheel and the ground to shorten the distance of the landing run. However, the effectiveness of this method is always related to the quality of the runway. For instance, the northern part of our country is very cold in winter and the cement runway is easily iced over after snow. Thus friction is greatly reduced and the effect of the brake

deteriorates. Furthermore, our southern part has higher temperatures in summer (it reaches to 40-50°C at the airport). Under this circumstance, the damage to wheels is high; the wheels could even burn, explode, and cause an accident. Therefore, under conditions where the temperature and airplane landing speed are both high, one should be very cautious in applying the brakes. In addition, brakes should not be applied at the moment of airplane touchdown, because this generates a large nose-down pitching moment and causes the front wheels to hit hard on the ground; either the front wheels will break or the airplane will bounce. The brakes are used only after all wheels are on the ground. The effectiveness of the brake is then limited.

BRAKE PARACHUTE

Everyone knows that although a parachute is usually wrapped in a smaller package, it can open to a very large drag area when necessary, allowing parachutists a safe and slow landing. Thus, men tried very early to use the parachute as a device to reduce the speed of an airplane. After a number of scientific tests a high strength airplane brake parachute, which is also called an airplane drag parachute, suitable for opening at high speeds was finally designed. The drag parachute has a very large drag area when open and produces large aerodynamic drag. At the same time, it is not affected by the quality of runway as is the brake of the airplane wheels. In the hot summer of our country, the temperature is rather high and the results from braking an airplane wheel are poor. Thus, it is more ideal to use the drag parachute to reduce speed. The higher the speed of an airplane, the better the results of the drag parachute. Therefore, it is more suitably applied to different military aircraft with higher landing speeds.

In order to better utilize the special features of the drag parachute, i.e., its better results at the higher speeds of the airplane, all countries in the world changed the technique of deploying the parachute from so doing after landing to deploying before landing.

OPENING THE PARACHUTE IN THE AIR

Its working principle is shown in Fig. 4, that is, opening the door of the drag parachute compartment when the airplane is about one meter above the ground, as shown in Fig. 4 (top). When the airplane wheels touch down, the drag parachute is fully open, as shown in Fig. 4 (middle). Due to the high drag caused by the parachute, the speed of the airplane is reduced very rapidly. When the speed of the airplane is reduced to 20-30 km/h, the pilot pushes a button to discard the parachute so that the parachute is not broken by the drag, as shown in Fig. 4 (bottom). But for opening a parachute in the air there must be certain requirement for the location of the parachute compartment. The percussive force due to the parachute's opening will cause a nose-down pitching moment. If the parachute compartment is located below the tail of the fuselage (as in Fig. 2), the airplane must be controlled to compensate this moment, otherwise it will break the front landing gear of the airplane. Therefore, for opening the parachute, the parachute compartment must be moved to the upper part of the jet nozzle and lower portion of the rudder (as in Fig. 3) at the tail of the airplane, as close to the horizontal line of the center of gravity of the airplane as possible. Thus, the danger of breaking the front landing gear could be avoided, and the safe landing of the airplane could be ensured. Usually, the drag parachute is not heavy. The procedure for opening the parachute is simple; it is generally installed at the tail of the fuselage and does not cause any special problem. Because of greater advantages, better results, and less effect on environmental conditions by using the drag parachute, it plays an important role in landing.

Of course, the above mentioned three braking methods, wheel brakes, flaps, and drag parachute, are often used together in the airplane landing. If they are used in a proper combination, the landing run of the airplane could be greatly reduced. According to statistics, the length of the landing run of a 6- to 7-ton pursuit plane can be shortened to 700 to 800 meters; that of a

50- ton bomber can be shortened to 1,200 meters; and that of a 100- to 150-ton heavy bomber can be shortened to 1,500 to 1,800 meters. Comparatively speaking, the distance of landing run after employing the landing-speed reducing measures can be reduced by more than two thirds.

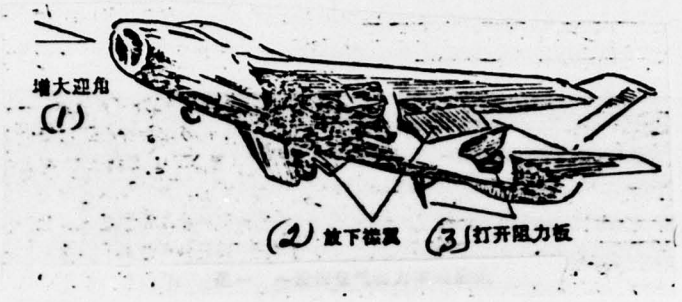

Fig. 1. General aerodynamic speed-reducing device.

KEY: (1) Increasing landing attack angle; (2) Lowering wing-flaps; (3) Open air damper.

Fig. 2. Defect of locating parachute compartment at lower part of fuselage.

KEY: (1) Lower parachute compartment; (2) Moment of the opening of parachute; (3) Center of gravity of airplane.

Fig. 3. Advantage of locating parachute compartment near center of gravity.
KEY: (1) Higher parachute compartment; (2)Center of gravity of airplane.

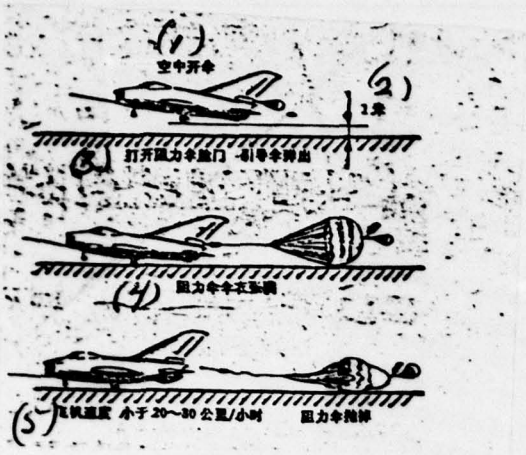

Fig. 4. Diagram of the parachute opening procedures in the air.

KEY: (1) Opening the parachute in the air; (2) Meter; (3) Open the door of drag parachute compartment. Pilot parachute shoots out; (4) Drag parachute opens in full; (5) Airplane speed less than 200-300 km/h. Drag parachute is discarded.

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